PENDANT - Pan-European Co-ordinated Accident and Injury Databases

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ABSTRACT

Annually within the European Union, there are over 40,000 road accident fatalities and 1.6 million other casualties and the majority of these are either the occupants of cars or are in collision with a car. The European Commission now has competency for vehicle-based injury countermeasures through the Whole Vehicle Type Approval system. As a result of this, the Commission has recently recognised that casualty reduction strategies must be based on a full understanding of the real-world accident data in conditions broadly representative of the European Union and that vehicle safety countermeasure effectiveness must be properly evaluated.

To this effect, a new study known as PENDANT (short for Pan-European Co-ordinated Accident and Injury Databases) commenced in January 2003. This study is developing a co-ordinated set of targeted, in-depth crash data resources to support European Union vehicle and road safety policy. Over the course of the next three years, around 1100 investigations of crashes involving injured car occupants will be conducted in eight EU countries to a common protocol. The data will be further enhanced by the linking of hospital and police information to provide additional data on the trends and injury patterns of over 60,000 road users of all types.

This paper describes the methodology and purposes of the study and expected impact within the European Union. It is expected that the end result of the study will be a co-ordinated system to inform European vehicle safety policy in a systematic integrated manner. Furthermore, the results of the data analyses will provide new directions to develop injury countermeasures and regulations.

INTRODUCTION

Annually within the European Union, there are over 40,000 road accident fatalities and 1.6 million other casualties. Such accidents cost the Community over 160 billion Euros annually. If the additional road toll of approximately 23,000 persons killed each year in the EU's associated states were to be taken into account, the annual socio-economic cost would be around 250 billion Euros.

The majority of those killed or injured are either the occupants of cars or are in collision with a car. Recently, there has been recognition of a need to reduce the numbers of those killed and seriously injured on the roads across the EU. In 2002, the EU adopted as a target a 50% reduction in fatalities by the year 2010.

Since the Maastricht Treaty was formalised in 1992, the European Commission has assumed competency for vehicle-based countermeasures through the Whole Vehicle Type Approval system. However, casualty reduction targets and strategies need to be based on a full understanding of the real world in conditions that are representative of the EU as a whole. Accident studies are an essential part of this process. However, harmonisation of general activity within the EU has historically been limited by language and cultural differences. Therefore approaches to accident study methodology differ somewhat between member states.

Until now, there has been no co-ordinated EU mechanism available to the Commission to provide a suitable resource with which to support new safety actions and to provide feedback. A major gap concerns the availability of Pan-European data on injuries and their causation for qualitative and quantitative support for European policy although such an approach was proposed by Thomas et al (1996).

Recently, as part of the harmonised approach to accident data collection, as from the 1 January 2003, the Pan-European Co-ordinated Accident and Injury Databases (PENDANT) study commenced in Europe. The study will provide new levels of vehicle crash and injury data to support EU vehicle and road safety policy formulation by developing two new European data systems and development of accident data collection protocols. Whilst the study concentrates solely on protection of vehicle occupants, it is expected that the infrastructure that is being developed for the study will be used to study protection of other road users such as pedestrians and motorcyclists.

METHODOLOGY

Essentially, the PENDANT study is divided into three programmes of activity and these are now considered in turn.

Work Package One - Development of accident investigation tools and procedures

The Purpose of this programme is to develop methods to ensure that in-depth accident and injury data collected by several organisations is directly comparable. In particular, two tasks address the harmonisation needs of the fundamental crash parameters of collision severity and injury outcome required for Work Programme two and three described below. The remaining task addresses the need for new analytical methods to ensure accurate casualty reduction estimates from the geographically distributed datasets developed in Work Programmes two and three. This Work Programme is divided into a number of tasks as follows.

Task One

The STAIRS Project (Thomas et al, 1996) identified a lack of harmonisation over collision severity assessment as a major limitation regarding the comparison of crash test speeds with real crashes. The objective of this task is firstly to develop methods and guidelines for the reconstruction of road traffic accidents to be used by the different research groups who will perform these types of reconstructions in Work Programme two.

Secondly a database will be developed which includes the main information about available public domain crash tests (for example, Euro-NCAP). This database will provide available information about the acceleration characteristics of the vehicles, occupants and injury criteria as well as intrusion data with well-documented photographs for deformation assessment.

Thirdly, methods will be developed for determining the comparability and accuracy of reconstruction methods. The desired results of such a reconstruction are the determination of (pre-) crash speeds, the speed changes caused by the crash (Δv) and the energy dissipation from the deformation during the crash (EES, EBS) of all involved vehicles as well as avoidance considerations like avoidance speed, deceleration or reaction time. Furthermore, the work will be linked to other existing studies. The methods assessed will comprise all of those routinely used in the studies including scene-based, energy-based and crash recorder-based methods. The relevance of each measure for each collision type will be defined.

The applicability of the various methodologies will be validated on existing results of a sample car to car crash test as well as on test results which are already available, like the EuroNCAP crash tests (for *absolute* comparison) and real world crashes (for *relative* comparison). Computational methods will provide further verification of the methodologies and analytic methods will be developed to estimate the normal confidence limits of each technique.

Specific reference will be made to the use of smart technologies to collect and retain information about the crash ("Black boxes", "crash recorders"). The Task will examine current capabilities and identify the main obstacles to their wider implementation.

Task Two

Measurements of injury outcome are the second set of fundamental crash parameters accompanying collision severity estimates. This task addresses the accepted injury scale measuring threat to life (Abbreviated Injury Scale) and makes recommendations for harmonised application to in-depth injury data and improved relevance to field data.

The methods used will include a review of injury coding methods, identification of the limits of the available scales, identification of areas of divergence in application and develop proposals for improved methods. These proposals will be incorporated within the injury scaling conducted within programmes two and three.

Task Three

Policy decisions over the relative benefits and costs of different casualty reduction methods rely on comparable estimates of injury and casualty reductions in the crash population. This task will develop and validate a harmonised analytic procedure that has general applicability to both injury and accident causation countermeasures. The methods will utilise the data collected in programmes two and three as well as available accident data to predict casualty reductions for the EU based on the prevailing accident and injury distributions. The methods will include engineering assessments of the effectiveness of the technologies under well-defined conditions that will then be expanded to the full range of crash circumstances seen in the real world.

In a first step, a statistical analysis will be performed to compare the casualty of single accidents of cars with and without Electronic Stability Programme (ESP). In a second step the most well documented 30 (if available) single car accidents with cars not equipped with ESP will be

identified by the first analyses from the in-depth database collection in programme two. These accidents will be additionally investigated and reconstructed. In comparison, each case will be simulated with the assumption that the cars are equipped with ESP. The differences regarding accident avoidance or severity as well as reduction of injury risk will be investigated and the effectiveness will be documented.

The influence of engineering countermeasures will also be investigated using a general simplified multi-body car model for the collision phase which will be used to predict the acceleration, deformation and intrusion behaviour of the cars involved in a real world accident. The possibility of adapting this multi-body model to specific car makes and models will be explored. The validation of these models will be based on the crash test database developed in task 1. The simulation results of this new tool can then be used as input for occupant simulation to predict injuries or the effect of engineering countermeasures on the injury risk of the occupants. Statistical methods will be developed to relate the individual injury reductions to the complete crash population.

Work Package two – Development and analysis of a representative in-depth crash injury database for car occupants and pedestrians

This work package brings together the resources and infrastructures of existing accident and injury investigation groups to build a demonstration European Crash Injury database. There will be capacity for continuation after the completion of the main project such that a central European resource to inform road and vehicle passive safety decisions and policy-making will be available. It is directly complementary to Work Programme three and will utilise the results of Work Programme one. When established this database will be used to examine the injury prevention priorities for future action and to provide feedback to casualty reduction measures such as the EuroNCAP rating system.

The objectives of the Work Programme are:

1. To enhance the STAIRS methodology (Ross et al, 1998) to develop a dictionary of data fields for both passive and active safety;

2. To develop a system to investigate the causes of injuries based on the STAIRS methodology in eight countries;

3. To develop a standardised, demonstration database system to facilitate data entry and combined analysis;

4. To investigate at least 1100 accidents involving injured car occupants and compile the data into the database;

5. To analyse the composite database and identify priorities for future European regulatory and other action.

This Work Programme is based around the main data collection and database construction activity and contains the supporting tasks necessary to ensure that data is consistent and validated to the levels specified in the STAIRS study. The level of detail recorded for each case will be considerable as the STAIRS protocol specified 400 variables covering accident, vehicle, casualty and injury attributes. These will be included in the dataset together with the relevant CAREplus fields for each crash so the resulting database will have a substantially greater level of detail than CARE. However, where possible, the common data element definitions used in CARE will be used in the data elements of the PENDANT database. Furthermore, PENDANT will propose a list of common data element definitions to be used in the CARE system. The groups collecting the crash injury data cover northern, middle and southern Europe to give a representative range of accident conditions. A special feature of the data will be the case selection methodology that will be targeted to cover newer vehicles to give data that has most value for regulation and safety countermeasures, unlike most other systems. Furthermore, crashes will only be included in the sample if they involve an injured car occupant. The data collected will be analysed using the procedures developed within STAIRS to give results that are representative of the European crash population. The European organisations responsible for accident data collection are as shown in table 1 and the geographical locations shown in figure 1.

Table 1.
Partners Involved in PENDANT Project

Organisation	EU country represented
VSRC, Loughborough University (PENDANT Co-ordinators)	United Kingdom
Medical University of Hannover	Germany
INRETS	France
Chalmers University	Sweden
INSIA	Spain
Turku University	Finland
TNO	Netherlands
Technical University of Graz	Austria

Figure 1. Geographical Location of PENDANT Data Collection Centres.

Each team will collect the same data using the same selection criteria and protocols. The data will be fully compatible with the STAIRS protocols although the precise data collection methods will vary according to local requirements.

The database will provide the key tool for entering, validating, accessing and analysing the data collected. Database development will take place over two phases, phase 1 will provide a basic data system that permits each team to enter, modify and store the data. The second phase will be the analysis system that will evaluate and check the data and provide a mechanism for analysis.

Work Package three – Harmonisation of Hospital Data-bases

The objectives of the Work Package are: -

1. To review existing hospital data systems in three countries with regard to comparability of approach, commonalities and strengths of each dataset;

2. To specify common data elements and sampling requirements to support interpretation of the co-ordinated datasets involving details of over 60,000 casualties;

3. To specify appropriate analytic methods to facilitate co-ordinated analyses within the constraints of confidentiality of personal medical information;

4. To analyse the databases and identify priorities for future European regulatory and other action

This Work Programme uses pre-existing hospital based data and links it to other data such as police, demographic or economic data to develop a new level of detail and case numbers. The available data comes from three sources in France, Netherlands and Spain and covers all road user types.

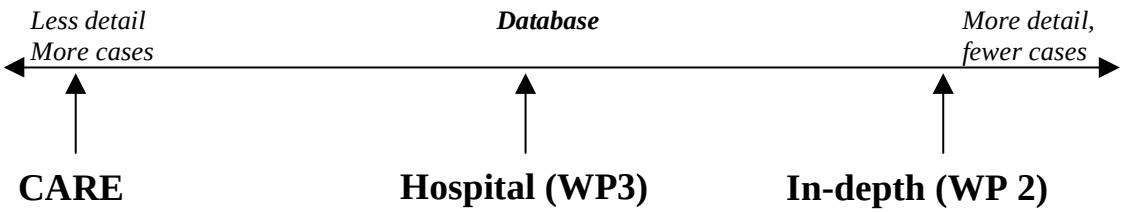

Figure 2. Level of Data in PENDANT Study.

The database will directly complement both the in-depth data (high detail but fewer cases) and the CARE data (low detail but many cases – figure 2).

Together the three countries' datasets provide a well co-ordinated European accident and injury database system. Each provides a complementary perspective on accident and injury causation.

In many countries, both on the national level and in regional and local areas, accident data are already available from medical sources, such as hospital-based data. This type of data covers relevant injury data (both in terms of description of the injuries and in terms of injury severity), treatment data and some general accident data of traffic casualties admitted to hospitals. By linking or matching these data to national (police based) accident data, other detailed and relevant accident data become available for analysis purposes. Further matching to relevant vehicle data enables the user of these data to study the full spectrum of traffic-accident data (general data, injury data, and vehicle data).

Normally, the number of cases in a hospital based data sample is far more than those from in-depth sources. Furthermore, completeness and representativity of hospital-based data can be more simply achieved than in case of in-depth data. The relevant injury data from these sources are normally already available in formats complying with international standards, such as ICD-codes and AIS-codes, the latter being the preferred format for use in analyses and comparison with results of in-depth studies. For this reason, an attempt will be made within this programme to link the available hospital data (in Work programme 3) with the in-depth crash injury data (collected in Work Programme 2) in a uniform way although there are a number of considerations that need to be made including compatibility of the databases. The hospital data is available from the following sources (see Table 2).

Table 2.
Hospital Data Sources

Source	Typical number of casualty records per year	Years of data
INRETS, France	11,000	Since 1996
MUH, Germany	40,000	Since 1992
IMSP, Spain	17,000	Since 1997

Task One – Review of Existing Systems

The similarities and differences between the three hospital based systems will be reviewed. Key aspects include:

1. Identification of the system (system identification properties, such as name/acronym, owner/institute and general description of the system, including area covered and history)

2. Structure (structural properties such as annual number of cases, main features of the system)

3. Sampling and selection criteria

4. Methodologies (how the data are gathered, what protocols are used, which classification systems are applied)

5. Content (listing of data elements, variables and their definitions)

6. Application (List of publications concerning the systems, results of analyses based on the data, their representativeness etc.).

The opportunities from differences and similarities of approach will be identified together with the implications for comparative data analysis.

Task Two – Data Protocol Development

A harmonised set of data fields will be specified to facilitate analysis based on new transformation rules developed for each dataset. Where information is available from the linked police data this dataset will include the fields specified within CAREplus so as to improve compatibility with the wider EU databases.

A special feature will be the development of harmonised statistical approaches to match police and other data to the hospital data. Probabilistic, direct matching by identifier, manual and other methods will be assessed to specify the prime requirements for the process to result in optimum matching accuracy and efficiency. The three partner countries have the data (hospital data and police data) available for analysis as separate annual data sets. The linking to each other (and the linking to vehicle registration data) is a specific item for which the infrastructure (method) has already been developed, but for which this method has to be applied to the data of recent years in this EU-project.

Task Three – Data Analysis

The three datasets will be analysed to support the policy and non-regulatory decision making of the Commission. Precise subjects will be specified at the time of analysis with the support of the EC but are expected to address issues such as the trends and patterns in the injuries of vulnerable road users, the association between specific vehicle models and injury (quantification of the "EuroNCAP effect" for example) as well as other issues which border onto a public health dimension.

Special consideration will be given to ensure that observed differences between datasets are not artefacts resulting from different procedures but represent true differences in injury causation.

DISCUSSION

The growing demand for greater mobility in European society has made individual transportation an essential feature of modern living. The motorised transport of people and goods has grown to such an extent that 2,500 billion kilometres are covered every year by motor vehicles on European roads. With this traffic increase, the risk of becoming involved in a serious accident has also risen. As already stated, in the fifteen member states of the European Union, each year there are more than 40,000 people killed and 1.6 million injured, which represents an unacceptably high burden on Europe's society and economy. The impact of road accident casualties is a major public health problem for Europe.

The PENDANT project will contribute to better protection of road users, in particular car occupants. It is expected that the PENDANT project will have a wide-ranging effect on scientific and technological prospects in a number of areas. It is hoped that there will be considerable improvements in the understanding of the causation of injuries to all road users in real-world crashes. The investigation relationship between the injuries themselves and the loads applied should provide new information relating to the design of crash test dummies and their instrumentation. The knowledge of the real-world performance of existing safety systems should help to improve the safety benefit of new generations of technology, it will also support the development of new methods to assist crash test procedures and ensure good crash performance in the laboratory means good performance on the road.

It should be remembered that the growth of the European Union with inclusion of ten new accession countries (Czech Republic, Hungary, Poland, Malta, Cyprus, Slovenia, Slovak Republic and the three Baltic States) means that in years to come, data collection should be expanded to a number of other Centres to maintain representivity of the European situation. Furthermore, whilst at present, the study is limited to investigations of

passenger vehicle crashes, it is hoped that other types of crash investigations involving pedestrians in particular can be incorporated into the PENDANT infrastructure.

The automotive industry has a corresponding responsibility to reduce the individual suffering as well as costs for society. By developing products and methods that will reduce the risk of injuries, significant benefits could be achieved in terms of reduced injury costs and suffering.

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